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III. A Study of Orchard Problems by the Budget Method of Analysis

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STUDIES IN ECONOMICS OF APPLE GROWING BY BUDGET ANALYSIS

by H. C. Woodworth and G. F. Potter

A detailed study was made of twelve fruit farms, and two bulletins were published: one in 1931 on costs and management of fruit farms and the other in 1934 on fruit farm organization.* In these studies, it early became evident that certain fundamental and important problems could not be approached by the usual method. A study based on a brief period ignores important biological processes. The entire cycle of the orchard's life needs to be examined.

Thus, in connection with the studies already published, additional data were collected and organized and used in exploring orchard management problems by a budget type of analysis. For instance, comparisons were made as to the relative profitableness of three systems of orchard plantings which involve (1) permanent trees only, (2) permanent and semi-permanent trees, and (3) permanent, semi-permanent and filler trees. The relative value of trees at different ages and the effect of late bearing were examined by the same procedure.

The results of these explorations have been used in extension work for a number of years, but publication has awaited an opportunity to check the data and re-examine the methods used.

In the last two years, some new data have been collected and the other data have been re-examined, refined, and adjusted to new practices and again used to study orchard problems.

Problem

The orchardist in setting out apple trees is projecting a business enterprise several decades into the future. In addition to making the initial investment in land, trees, materials and labor in starting the orchard, he has begun a program that involves continuing annual investments and expanding operations for many years. It is of course impossible to predict the many new and difficult problems to be encountered in a long production period. On the other hand it seems important to discuss some of the factors that probably will concern the orchardist.

On the financial side, the usual approach has been to determine the cost of growing trees to a ten-year age, crediting the sale of apples to the cost of growing the trees. Thus it is arbitrarily assumed that the first ten years is a process of growing a tree, and that from then on the process is growing apples. But the apple tree passes through a biological life cycle. It grows and develops over a long period, matures and then gradually declines.

Even though the final product is apples, the orchardist directs his resources toward the growing of joint products, trees and apples, in ever-

* Bulletin 257, Studies in Economics of Apple Orcharding, I. An Apple Enterprise Study—Costs and Management, H. C. Woodworth and G. F. Potter, New Hampshire Agricultural Experiment Station.

Bulletin 279, Studies in Economics of Apple Orcharding, II. A Study of Farm Organization on 12 Fruit Farms, H. C. Woodworth and G. F. Potter, New Hampshire Agricultural Experiment Station.

changing proportion over most of the long production period. In the initial stages activities are centered on growing trees. In the early bearing stages the emphasis is still largely on developing the trees, but over a long period the production of fruit gradually becomes the dominant objective. In the final stage the operator's attention is absorbed in getting as much production from the old tree as is practical. At the end of its commercial life the tree is valueless for fruit production.

Whenever joint products emerge from a production process the problem of studying management becomes complicated. In the case of apples an understanding is made difficult by the long period of 40 to 60 years in the life of the apple tree. If we had an orchard of 60 acres in which acre age groups from 1 to 60 years were represented, and if each year an acre of the oldest trees were replaced by new plantings, the problem in any one year would indicate more accurately certain phases of the real situation faced by a producer in planting a large new orchard. And yet this would not be a true cross section because starting with a newly-set orchard the operator experiences the long period of waiting for an income and his operations are constantly expanding as the trees grow.

In exploring the problems of fruit production it seemed wise to carry the orchard through its life cycle without arbitrarily setting an age limit representing the growth of the trees as a production factor. Due to the long period involved, a budget type of analysis appeared to be the most practical approach.

The first step was to organize the data to indicate the inputs for each year through the entire life cycle. Several orchards had been set out during the period of observation and the data available were carefully checked as to possible improvements in method. Records were available on orchards at other stages. These were adjusted on the basis of improvements in methods and then used as a background for estimating the cost for each year. The resulting curves representing inputs at each

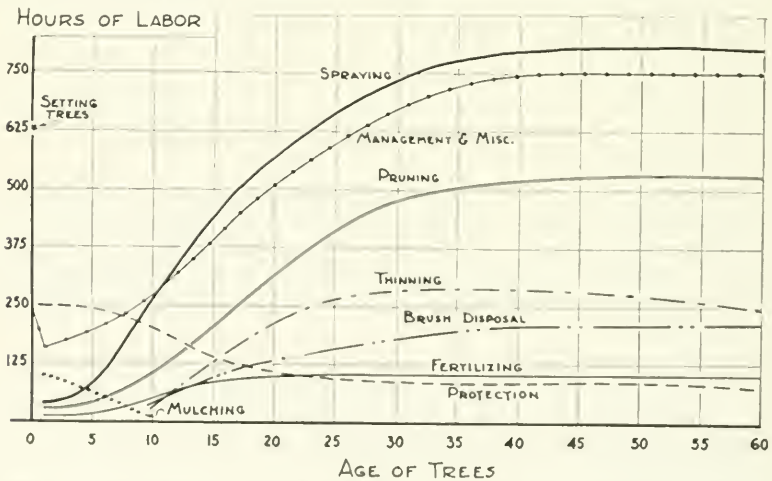

FIGURE 1.—HOURS OF LABOR PER 1000 TREES REQUIRED EACH YEAR ON VARIOUS ORCHARD OPERATIONS, NOT INCLUDING HARVESTING.

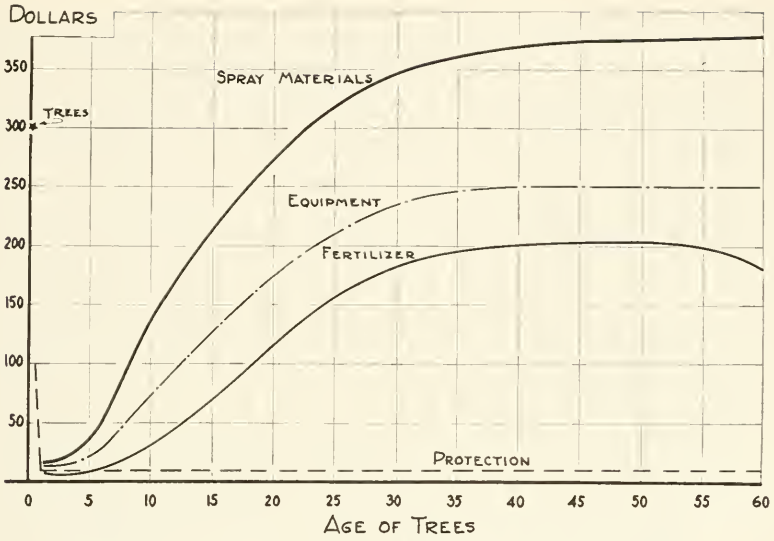

FIGURE 2.—ANNUAL COST OF MATERIALS PER 1000 TREES.

age were constructed on the basis of the estimated situations under efficient management. A sod mulch system was considered standard.

Labor inputs

In figure 1, the labor inputs in terms of man hours for each operation on 1000 trees for each year are shown by means of curves. Individual practices vary greatly on different farms and in constructing each of the curves economic and efficient practices were stressed. The labor in setting trees the first year is indicated by a star and resetting in the second and third year is estimated under management and miscellaneous. The curve for spraying represents the amount suggested for adequate protection rather than the amount used by some of the growers.

Out-of-pocket costs

In figure 2, the costs of trees, spray materials, use of equipment, fertilizer, and materials for protection are shown. The cost for the use of equipment is shown as a smooth curve. This of course is an estimated yearly charge for the use of equipment based on value and depreciation of adequate machines.

Labor and materials are per tree costs

The labor requirements are related almost entirely to the number of trees. In setting out, pruning, protecting, and fertilizing, the operator works on individual trees. The costs involved are per tree costs. If trees are close together there is less walking between them, but this does not represent a significant difference in labor. One exception is mowing, which may be considered a per acre charge. On the other hand, with fewer trees there will be more mulch per tree.

Labor in the form of man hours and materials, expressed in terms of money costs, have been plotted separately for the life of the orchard since

the labor requirements may not represent out-of-pocket costs, and certain operators may need to treat the item of labor on a different basis. However, in order to carry the budget analysis along, a fixed labor rate of 40 cents an hour has been assumed. Some other rate, higher or lower, could have been assumed and individuals may need to adjust the labor curve to fit their conditions. It is assumed in the case of labor on fruit that since a long period is involved the opportunity cost of the operator's labor might approximate 40 cents per hour. It is recognized that many fruit men might find themselves in a position in which the orchard could be carried along for several years without hired labor or loss of other income.

The total cost of materials and the estimated value of labor at 40 cents per hour are shown in figure 3. Since the curves for labor and materials are separate, the individual operator can easily adjust the curve of total cost to fit his particular condition.

On the whole the lands used for fruit growing are not high in value for alternative productive crop enterprises. However, fields representing good fruit sites may be associated with a farmstead in which alternate use of the entire farm or pattern for summer or other purposes has required a large investment, and the use of a particular site is not available to an individual without purchase of the entire farm. Thus individuals have made sizable investments for orchard sites. For the purposes of this study, these situations are ignored.

In some instances potential orchard sites are marginal for other agricultural uses. Such fields are in the twilight zone of uncertainty with abandonment a strong possibility. If such a property is owned by an

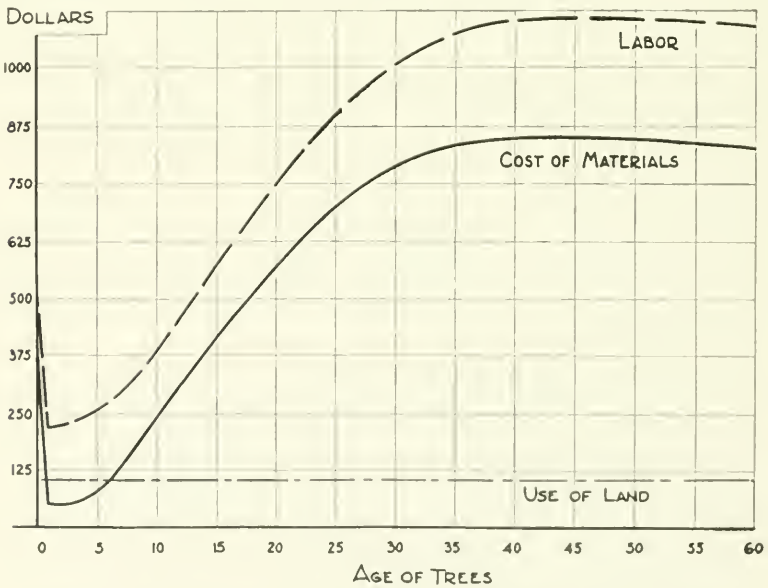

FIGURE 3.—ANNUAL COST OF LABOR, MATERIALS AND LAND FOR 1000 PERMANENT TREES (PLANTED 27 TO THE ACRE).

individual who contemplates setting an orchard, what is the annual land cost to him? Ignoring what he may have paid for the land, if it is on the verge of diversion to forest, its values can be estimated on the basis of its worth as forest land, which would be small. That is, starting with a cleared field, returns from forest uses may be 100 years away and possible income discounted backward 100 years means a very small value now.

From this angle individuals who contemplate developing orchards on such land can associate only a small investment with it. Marginal land reverting to forest uses is probably worth not over $2 to $5 per acre.

On the other hand, in New Hampshire the area of land on a farm is a mixed pattern of tillage land, pasture land and woodland with a farmstead associated with the general pattern. In the case of a farm with 40 acres of tillage land, 50 acres of rough pasture land, and 100 acres of forest land, an orchardist would usually have to purchase the entire farm. The 40 acres of tillage land might have only 20 acres of good apple land. Thus, if the orchardist is interested in nothing but orchards and ignores the other resources associated with the farm, the investment per acre of orchard land may be $200 an acre or more.

The best approach in management is to use all the resources of the farm to secure the maximum returns from resources and labor. If the farmer has an established dairy organization and is considering setting fruit, he should consider the effect of diverting certain fields to orchard. A careful estimate of the loss of income from less dairying and the possible net gain from fruit production would form a basis on which to determine the advisability of making the change. In many instances the loss of tillage fields for roughage production would so disrupt the dairy organization as to make the use of the land for orchard purposes very expensive. Yet on some dairy farms, fields could be spared for fruit growing without appreciable loss.

Since fruit growing is highly competitive from an inter-regional point of view, it seems wise to consider fruit growing largely on the basis of low value land. Many fields exist which represent potential apple sites and which based on present use and present returns have little value. Wherever the fields have high value for other purposes, one may question their use for orchards.

In confining tree fruits to low value land, one must have in mind the use of the best sites only. It is a great mistake to set out trees on any land not having the characteristics of a good orchard site. But it so happens that good apple sites are associated with farms or fields that are in process of abandonment. One instance is known where general farms were purchased and small acreages including the farmsteads were resold to summer people, leaving tracts of orchard land secured at a very small investment.

While the discussion in this bulletin will be restricted to the orchard enterprise, it is fully recognized that usually it is desirable to operate the orchard in association with other enterprises. The resources of land, equipment and labor can be better utilized in a well balanced farm organization. But for purposes of exploration the orchard will be studied

as a distinct enterprise. However, the association with other possible enterprises must always be considered part of the picture.

Costs associated with the use of land can be considered here on the basis of the alternate use value of the sites.

It is important to note that the costs for the use of land are distinctly per acre charges. As stated before, the costs associated with labor and materials are largely determined by the number of trees. The annual cost for the use of land will be a straight horizontal line indicating a constant amount each year.

Land valued at $40 per acre based on the highest alternative use value would represent an annual charge of $2.80 per acre assuming taxes and interest at seven per cent. For 27 permanent trees planted on an acre the annual cost would only be about 10 cents per tree per year. In planting 27 permanent and 27 semi-permanent trees per acre, there would be no additional cost involved in the additional 27 trees. In the same way fillers would involve no extra land cost. On some fields the operator might harvest hay on half the land in the initial stages of the orchard and in this event the growing of semi-permanents or fillers would involve opportunity costs.

Total operating costs

These three sets of cost items, labor, material, and land, represent the annual operating costs for the orchard. (Fig. 3) They are estimated of course, and may not represent the actual cash costs which each orchardist would face. They do indicate roughly the relative costs over the period.

The sum of all the expenses, including out-of-pocket outlays for materials, labor requirements at assumed rates of pay, and an estimated charge for land based on opportunity costs, are shown in figure 4. This cost curve is used throughout this study as the standard curve of costs throughout the life of the orchard. Whenever this standard curve is modified to study the influence of changing factors, the modification is definitely stated.

High and low land rentals

In order to study the effects of variations in land cost three additional curves were constructed: one based on $20, one on $80, and a third on $200 per acre value instead of $40 as in the standard curve. (Fig. 4) This is based on the use of permanents only. If semi-permanents and fillers are used, the cost associated with land would be less per thousand trees. (Fig. 5.)

High cost curve

The standard curve is based on efficient use of labor, something beyond the present average requirement but in line with the more efficient producers. There are fruit men who seemingly cannot organize their production processes to meet this standard and obviously would have to plan a large cost in terms of man hours. Perhaps the logical conclusion is that if they are less efficient the estimated rates of pay per hour would be less and that for the purpose of this study this difference in efficiency would not matter.

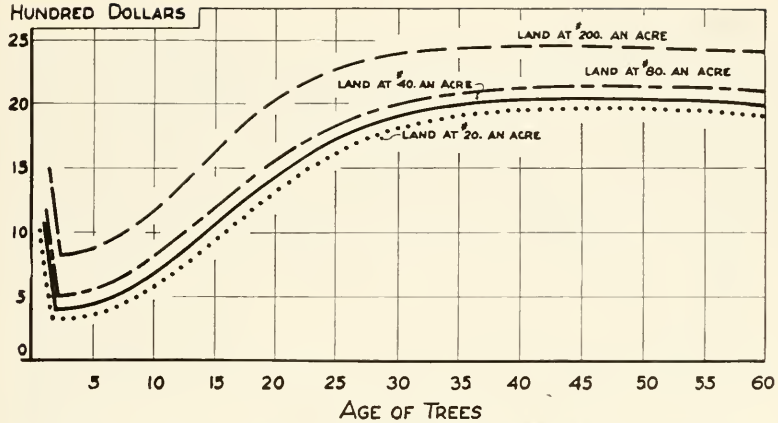

FIGURE 4.—TOTAL ANNUAL COST OF LABOR, MATERIALS AND LAND FOR 1000 PERMANENT TREES.

Planted 27 to the acre with land at different values. Land valued at $40 an acre was considered standard for this study.

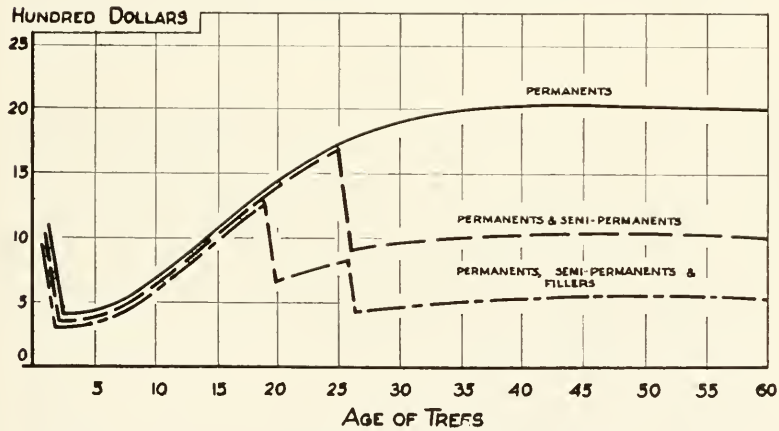

FIGURE 5.—TOTAL ANNUAL COST OF LABOR, MATERIALS AND LAND FOR PLANTING TREES.

Three methods of planting—1000 permanent trees (27 to the acre); 500 permanents and 500 semi-permanent trees (54 to the acre); and 250 permanents, 250 semi-permanents and 500 filler trees (108 to the acre).

The rate of wages where the operator does most of the work himself is more nearly a residue after other costs have been accounted for. But to take into consideration the fact that some growers have better alternative possibilities than others and also to take into account the differences in efficiency, a deviation from the standard curve was made on the basis of 30 per cent increase in labor cost. This has been labeled the high cost curve. (Fig. 6) Essentially this curve may be taken to represent the relative situation where the grower tends to putter along with the various practices and has not organized his activities on a mass production basis. The comparison can at least point out the need and the possibility of efficient management to those who put unnecessary labor on the orchard.

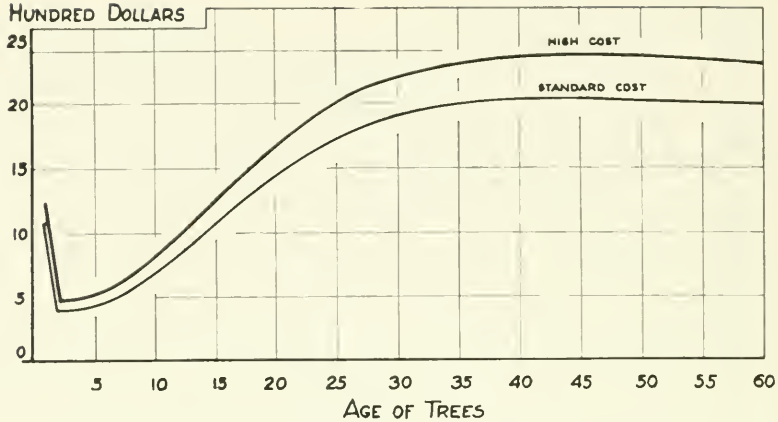

FIGURE 6.—HIGH COST CURVE AND STANDARD COST CURVE OF LABOR, MATERIALS AND LAND PER 1000 PERMANENT TREES.

The high cost curve is based on a 30% higher labor cost due either to inefficiency or higher wage rates. If labor were available on the farm, the out-of-pocket expense would be lower than the standard curve, especially in the early period.

Income

Yields

In the first bulletin of this series a curve representing normal expected yield for the commercial life of the orchard was developed. For this study this curve has been modified slightly by assuming 60 years instead of 65 as the commercial life of the orchard and also by cutting yields gradually after the fortieth year. There has been a growing realization that under present day conditions the profitableness of carrying the orchard beyond the sixtieth year is limited. Operators experience trouble in controlling fungus and insect pests in the large old trees, and due to lower quality the fruit is not as valuable.

The standard yield curve

The yield curve represents the estimated crop which can be expected under normal conditions of production in a commercial orchard under good management. (Fig. 7.)

It is a conservative estimate. Some producers on good sites have had much better yields, but on the other hand, many have experienced lower yields.

The delayed yield curve

It is well known that certain varieties such as the Spy tend to come into bearing late. In some orchards, due to management or some undetermined reason, trees of many varieties do not come into bearing normally. In order to study the effect of delayed bearing, an additional yield curve was constructed with the bearing age beginning at 11 instead of seven years of age. (Fig. 7.)

High and low yields

Due to poor site or some lack in management, such as deficiency in cross-pollination, the yields on some orchards are definitely substandard

over the entire production period. These orchards require the same care and materials.

On the other hand, the yields on certain orchards for reasons difficult to determine are much higher than indicated in the standard curve. Even in portions of the same orchard under the same management these differences occur. While the influences of these differences financially are obvious, the importance of getting good yields is made clear by the comparison of low and high yields. For this purpose two additional yield curves were constructed, one a yield 30 per cent below, and one 30 per cent above normal. (Fig. 8.)

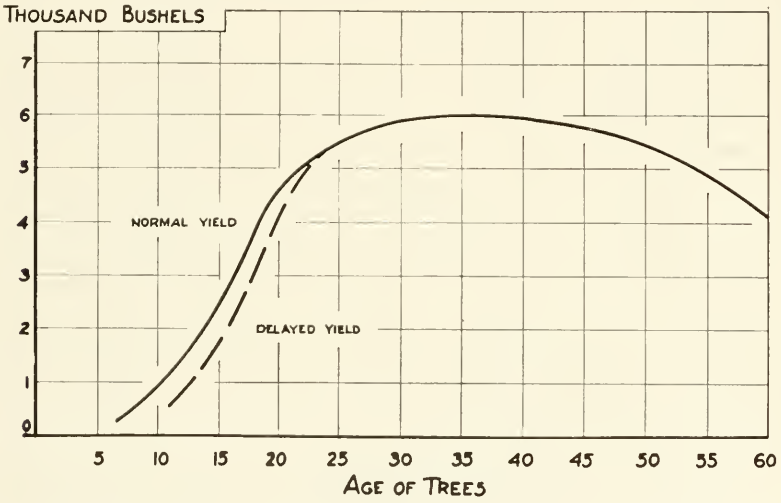

FIGURE 7.—NORMAL YIELD AND DELAYED YIELD PER 1000 TREES.

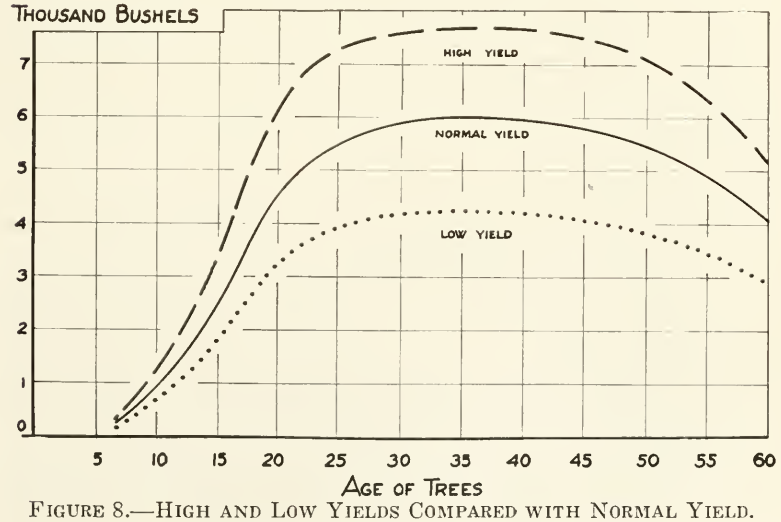

FIGURE 8.—HIGH AND LOW YIELDS COMPARED WITH NORMAL YIELD.
The site is an important factor in yield.

The semi-permanent and filler yields

The curves mentioned above are concerned with yields on permanent trees at the rate of 27 to the acre. It is assumed that if semi-permanent trees were added at the rate of 27 to the acre these would be cut out after the twenty-fifth year and that the crop up to this point would be approximately the same as that of the permanents. If in addition 54 filler trees are planted, it is assumed that these would be cut out after the eighteenth year and that yields would be the same up to this age. It is recognized that growers are reluctant to follow their original intention to cut out the fillers and semi-permanents at these ages. Damage is done if these recommendations are not followed. (Fig. 9.)

Price of apples

Under conditions of high price for apples almost any type or quality of management may be profitable. In studying management problems through the budget analysis it seemed sound to assume a price in line with recent trends, a price that would result in small margins, not enough to stimulate overplanting or the use of poor sites, but large enough to encourage operators to keep up their orchards, to make replantings, and to stimulate the occasional setting of new trees. Actually, orchards may vary greatly from year to year in yields, and prices may fluctuate widely. Individual orchardists over a 60-year period might experience occasional difficult years of small crops and low prices or prosperous years with large crops and high prices. For the purpose of this study a price of 60 cents per bushel of fruit on the tree was assumed, and the value of the crop each year was compiled on this basis.

Study of problems by budgeting

In attempting to study the management of orchards by budgeting over a long period it should be noted that the intention is to make broad relative comparisons. The would-be orchardist, in setting out a large block of trees, is mostly in the dark as to the problems which will come to him. While exact data on these problems are futile, decisions based upon an analysis of the best evidence available may be better than blindly projecting a long-time apple orchard enterprise.

In summary, the budget analysis is based on the curves described above and listed below.

On the cost side:

1. A standard cost curve (Fig. 4)
2. High labor cost (Fig. 6)
3. Variation in land cost (Fig. 4)
4. Variation in cost due to addition of fillers and semi-permanents (Fig. 5)

On the income side:

1. Standard curve of normal yield and returns (Fig. 7)
2. Delayed bearing (Fig. 7)
3. High and low yields (Fig. 8)
4. High and low returns (Fig. 8)
5. Variations due to addition of semi-permanents and fillers (Fig. 9)

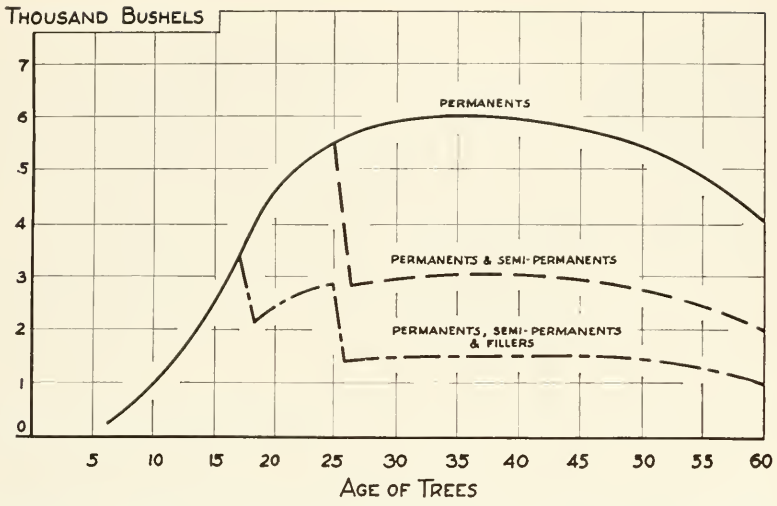

FIGURE 9.—YIELDS NORMALLY EXPECTED FOR EACH OF THE THREE METHODS OF PLANTING 1000 TREES—PERMANENTS, PERMANENTS AND SEMI-PERMANENTS, AND PERMANENTS, SEMI-PERMANENTS AND FILLERS.

These curves are based on definite assumptions which should be kept in mind at all times. In addition to the quantity estimates of inputs and outputs, a rate of pay of 40 cents per hour, a price of 60 cents per box of apples, and a land rental are definitely assumed. An individual operator can substitute a different value. Since there is no intention here to determine social costs but rather to make rough comparisons between several methods of management, moderate changes in rates do not affect the relative comparisons materially.

Influence of assumed varying land rentals

To the individual orchardist, the investment in land for the development of an orchard represents a cost item. Assuming standard yields on lands representing a cash purchase investment of $20, $40, $80, and $200 per acre, the relative influence of these land purchase values on the economy of the orchard can be traced. Land rental from the social point of view is a residue or that part of the income implicated to land, and naturally the income implicated as rent of land under conditions of similar yields and costs would be the same. But in these examples, it is assumed that due to associated or alternative use factors, land of equivalent ratings as apple sites has varying purchase price values.

An acre of land with 27 permanent trees would produce, assuming the standard yield curve, 6768 boxes of apples in the 60 year period.

Assuming five per cent as interest and two per cent as tax the yearly estimated rental per acre could be estimated at $1.40, $2.80, $5.60, and $14 on land purchased at $20, $40, $80, and $200 respectively. Over the 60 year period this would amount to $84, $168, $336, and $840 per acre respectively.

If only permanent trees, 27 to the acre, are grown, without considering the waiting, this would amount to 1.2 cents, 2.5 cents, 5.0 cents and

12.4 cents respectively on the above mentioned land rentals. But because the returns from the orchard are delayed the waiting period is an important factor.

The sum of annual rental charges of $1.40 compounded annually at five per cent for 60 years would be balanced by the sum of the annual yields in boxes of apples at 2.1 cents per box compounded at five per cent over the same period. For the higher rental charges the rate per box would be 4.1 cents, 8.3 cents, and 20.7 cents respectively.

The purpose of these estimates is not to indicate costs but to point out the relative influence or importance of varying land rental on the orchard economy. It should be evident from a study of these estimates that good apple land available at $20 an acre represents a relatively insignificant cost, but that the use of $200 land would result in an important cost item.

The planting of additional trees as semi-permanents or fillers resulting in more trees per acre does not involve additional land or additional expense for land. In a few instances where good tillage land is used for an apple site the operator may choose to intercrop for a few years between the permanents. There the planting of semi-permanent and filler trees would be considered in the light of the other possible intercropping uses of land. But much of the land which may be considered potential apple land is marginal for agricultural purposes and its use for apple production involves little loss in alternative income.

Comparison of types of planting

Until recently the usual planting of trees in New Hampshire orchards was 20 x 20 feet or 108 trees per acre. This was done with the intention of cutting out 54 fillers at the end of the eighteenth year and 27 semi-permanents at the end of 25 years, leaving 27 permanents. This practice is still followed by some fruit men although most recent plantings have contained only permanents and semi-permanents or 54 trees to the acre.

The usual procedure has been to compare these methods on the per acre basis, and of course if apples are figured on a high value basis the plantings with 108 trees to the acre may show the largest profits. But such a method ignores the real problems. Where the orchard site is definitely limited and family labor is available, it may be sound procedure for the operator to set out the additional trees. But under the conditions obtained on most farms, operating capital required to carry trees is a limiting factor and the operator's chief problem is to use his available resources in land, labor, and capital to the best advantage.

As stated on page 5 the main costs, whether stated in terms of quantity data or estimated in terms of money, are per tree costs. There is slight difference in the labor and material cost of growing 1000 trees to the eighteenth year whether set as permanents on 37 acres or as permanents, semi-permanents and fillers on 9¼ acres. The chief difference is the use of 27½ acres of additional land and some additional travel in carrying out orchard practices. Materials would be about the same in either case. The costs associated with the use of 27½ additional acres of $40 land would amount to about $77 a year or a total of $1386 for the first 18 years (not compounded).

Each individual operator setting out an orchard should study his various resources carefully and combine them to maximize his returns. If he has the desire and financial backing to set out and carry 1000 trees, and if he has considerable acreage of good apple land, the best combination might be the 1000 trees as permanents on 37 acres of land. On the other hand, if he has a definitely limited area, he might consider the combination of 500 permanents (60 years) and 500 semi-permanents (25 years) on 18½ acres of land. This combination will be more expensive per unit of product, but because of land limitations the volume of apples will be larger in the first years of the orchard's life.

If, however, prices of apples tend to adjust to the costs of the bulk-line farms, and if the operators on these bulk-line farms adopt the practice of growing only permanent trees, the operator who needs to grow apples on the basis of 54 trees to the acre is handicapped.

In figure 5 are plotted the estimated cost curves involved in setting out 1000 trees in each of the three methods of planting. These curves include estimated costs of labor, materials, and use of land but not credits for sales of apples. In figure 9 are plotted the gross returns based on standard yields and normal prices for each type of planting up to the end of the sixtieth year. In figure 10 are plotted the yearly net returns (income minus cost) from each of the three methods. In figure 11 these net returns are accumulated at five per cent interest to the twenty-eighth year.

At the end of the twenty-fifth year, the three methods would have involved no significant difference in total investment requirements except in the use of varying areas of land. The gross income from the three methods would be the same for the first 18 years, at which time half the trees would be cut out in method three. The income from methods one and two would continue equal to the twenty-fifth year, when half the trees would be cut in both methods two and three.

The inventory value of the permanent trees is the important factor in studying the results at the twenty-fifth year. The discussion of the relative value of trees of various ages and types on page 14 of this bulletin throws additional light on the problem. To summarize at this point, (Fig. 11) at the end of 25 years, method one would result in a net accumulated income of $2,900 plus the value of 1000 permanent trees; method two, $5,400 plus 500 permanent trees; and method three, $300 plus 250 permanent trees.

If one should estimate that the labor expense per tree was five per cent less in the second method and ten per cent less in the third method due to closeness of planting, the situation would be modified only slightly.

Influence of high labor cost

A rough comparison of an orchard under management involving high labor cost (resulting from either inefficient use of labor or higher wages) with one representing the normal situation is illustrated in figure 12. On the basis of an orchard of 1000 trees the net investment would be greater and the orchard would come out of the deficit at a later period. In the previous studies, there was little correlation between the amount of labor put on an orchard and the yields. In would seem that extensive management practices using labor efficiently and without fussing

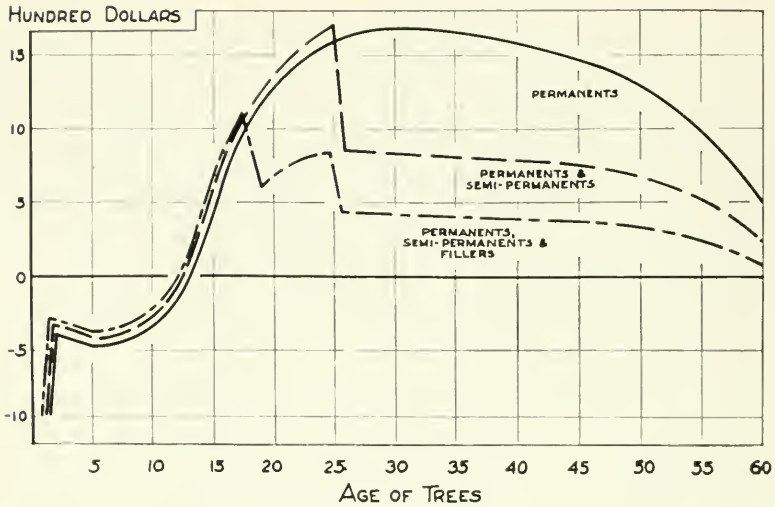

FIGURE 10.—ANNUAL NET RETURNS PER 1000 TREES FOR EACH OF THE THREE METHODS OF PLANTING.

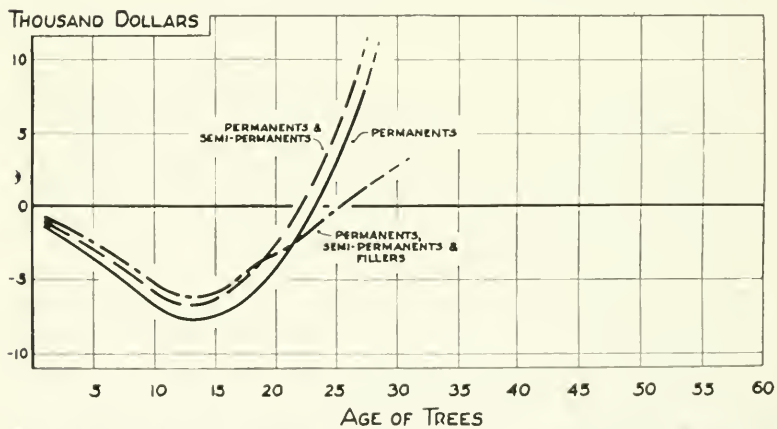

FIGURE 11.—ANNUAL NET RETURNS PER 1000 TREES ACCUMULATED AND COMPOUNDED AT 5% INTEREST FOR EACH OF THE THREE METHODS OF PLANTING.

The chief difference between the three methods is in the inventory. At the end of 25 years there would be 1000 trees, 500 trees and 250 trees respectively in the three methods.

seems to bring as good yields as intensive management. The spraying, however, must be thorough and timely.

Effect of late bearing

Late bearing orchards result in delayed income and the longer period of heavy carrying expense without income rapidly accumulates into a large total investment.

In figure 13 the annual net income on a delayed-bearing orchard is compared to one of standard yields. For this purpose the yields de-

scribed in the modified and standard curves in figure 7 are compared. On the basis of an orchard of 1000 permanent trees, the investment would be somewhat larger and the peak would come at a later period. On another basis the compounded net returns on the delayed bearing orchard would pass from a deficit to a surplus in the 31st year as compared to the 24th year in the standard yield orchard. The effect of delayed bearing is obvious and yet the study of the diagram should make the orchardist more conscious of the effect of delayed bearing on his orchard economy. Methods of insuring early bearing by selection of strains and varieties and by management should be studied. A distinct advantage of the McIntosh as compared with the Spy is the tendency toward early bearing. On this account the production of the Spy will involve higher costs.

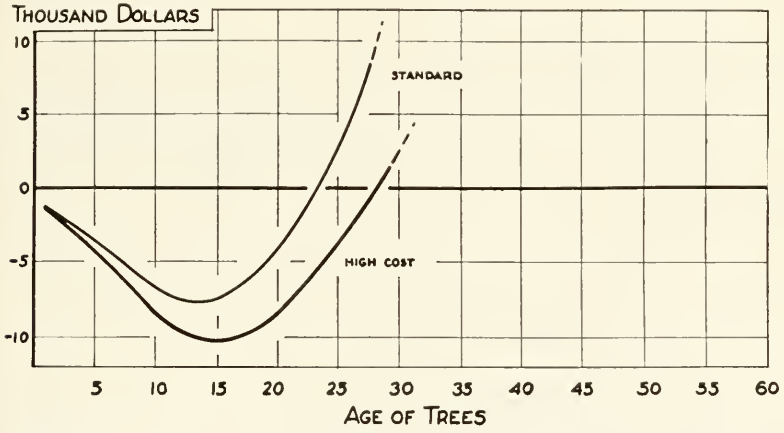

FIGURE 12.—ANNUAL NET RETURNS PER 1000 TREES ACCUMULATED AND COMPOUNDED AT 5% INTEREST WHEN COST IS ABOVE AVERAGE.

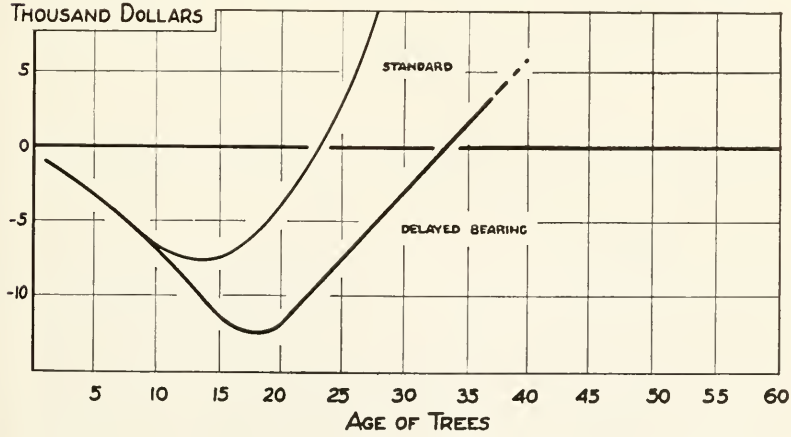

FIGURE 13.—ANNUAL NET RETURNS PER 1000 TREES ACCUMULATED AND COMPOUNDED AT 5% INTEREST WHEN BEARING IS DELAYED.

Effect of good and poor sites

To illustrate the effect of good and poor sites, orchards with low and high yield curves as indicated in figure 8 are compared to orchards with standard yields. The orchard on a good site has a peak in investment of $6,520 at 12 years, the orchard on poor site an investment of $14,363 at 60 years, as compared to an investment of $7,690 at 14 years in the standard orchard. The net returns compounded would bring the good site orchard out of the red in 20 years as compared to 24 years in the standard orchard. The poor site orchard would never pay. (Fig. 14.)

In the past insufficient attention has been given to the selection of apple orchard sites, yet the factors making up a good site are not too well known. But certainly before projecting a business like apple growing which will require expanding investments over a long period of time, the operator should study the site very carefully. The purpose of figure 14 is to indicate the importance of this study.

Combination of cost and yield

So far we have made use of the budget analysis to indicate a deviation in one factor of cost or yield as compared to the normal situation. Using the various curves representing varying costs and those representing varying yields, the influence of many combinations of circumstances can be illustrated. In figures 15 and 16 are shown several such combinations compared to the standard situation.

Fig. 15
1. Early bearing and low cost methods (standard)
2. Early bearing and high cost methods
3. Late bearing and low cost methods
4. Late bearing and high cost methods

Fig. 16
5. Poor site and low cost methods
6. Poor site and high cost methods
7. Good site and low cost methods
8. Good site and high cost methods

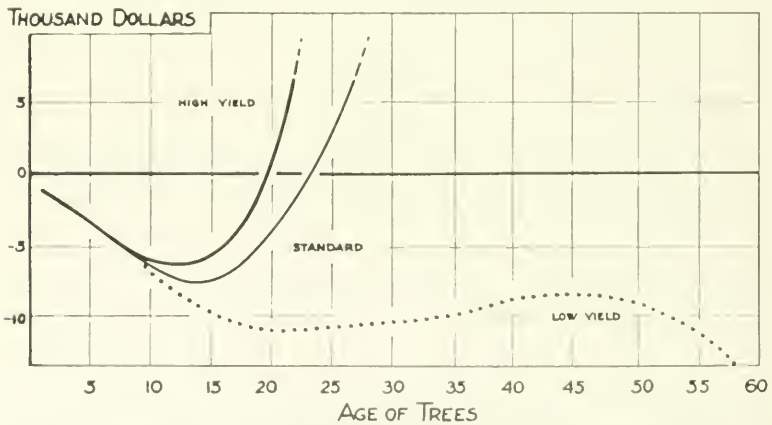

FIGURE 11. ANNUAL NET RETURNS PER 1000 TREES ACCUMULATED AND COMPOUNDED AT 5% INTEREST WHEN YIELDS ARE ABOVE OR BELOW NORMAL. (SEE FIGURE 8.)

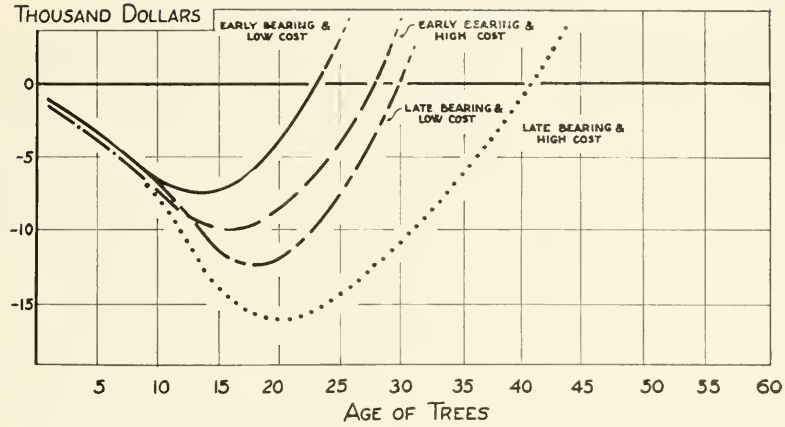

FIGURE 15.—ANNUAL NET RETURNS PER 1000 TREES ACCUMULATED AND COMPOUNDED AT 5% INTEREST FOR COMBINATIONS OF EARLY AND LATE BEARING WITH HIGH AND LOW COSTS.

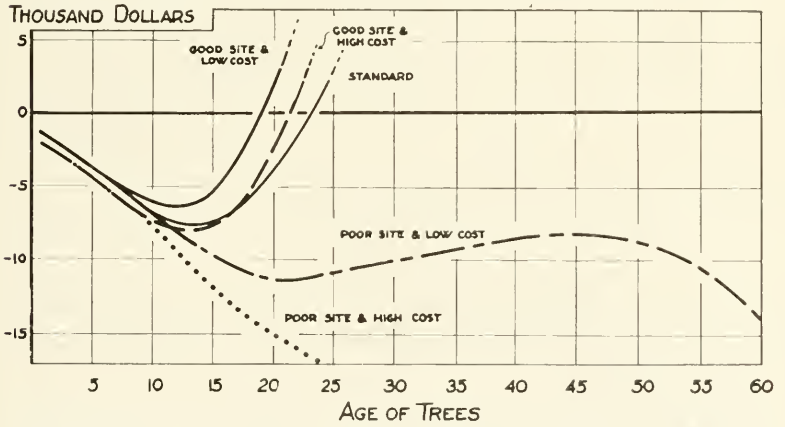

FIGURE 16.—ANNUAL NET RETURNS PER 1000 TREES ACCUMULATED AND COMPOUNDED AT 5% INTEREST FOR COMBINATIONS OF HIGH AND LOW YIELDS WITH HIGH AND LOW COSTS.

If it were possible to trace the financial history of the orchards of New Hampshire all these situations would be found. Most of the orchards have represented the favorable combinations, but a few with unfavorable combinations have brought tragedy to the owners. Often this has resulted from a chance combination of unfavorable circumstances and the result does not necessarily reflect on the business ability of the operator. Research and knowledge at the time of planting had not developed to the point of guiding the orchardist. Trial and error brought disaster to a few. The purpose of the curves in figures 15 and 16 is to point out roughly by budget analysis the need for a careful inventory of the situation and careful planning in the operation of the orchard before venturing to set out a large block of trees. And on the other hand, the curves should stimulate men to consider the possibilities of fruit growing under favorable conditions.

Inventory Value of Apple Trees

Because the orchardist is producing joint products, trees and fruit, in varying proportions from year to year, one of which remains as inventory, the financial status of the orchard is often indefinite. Some orchardists are carrying a large proportion of young trees and naturally a large part of the expense is directed toward the development of trees. A few orchardists have only old trees which will soon have no value. It is obvious that the orchardist who is taking out what he can from a declining orchard has a different problem than the operator who is carrying sufficient young trees to maintain the bearing capacity of the orchard.

The actual sales value of a definite orchard will depend on many factors, such as site, trees per acre, varieties, location with respect to markets and other orchards, the price of apples, and the size, age, and development of the trees. Both the seller and the buyer may give some attention to the future production possibilities.

In an open competitive market, with many orchard sellers and buyers, the selling price of the orchards by age classes would probably register roughly the general opinions as to the value of the orchard for productive purposes. However, few men buy or sell an orchard in a lifetime, and their economic analysis of the problem is largely rough guessing. In addition, the orchard sold is likely to be of mixed ages instead of a one age group.

In exploring the inventory value of apple trees by a budget method, the emphasis is on the relative value at different ages of different types, and no attempt is made to suggest actual values.

There is no intent to forecast the future of the apple industry. The shape of the curves of value is based on the standard cost curve and standard income curve in figures 4 and 7, and the same assumptions are made. No one should feel secure in using such curves for inventory purposes over a period of years without constant adjustment to changes in the apple outlook.

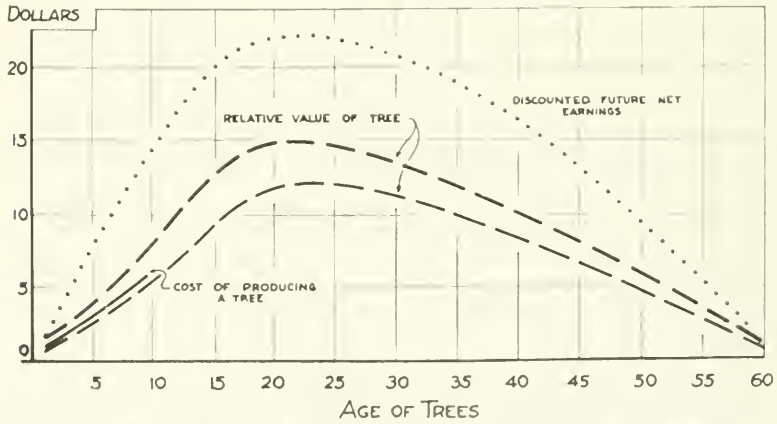

FIGURE 17.—INVENTORY VALUE PER TREE DERIVED FROM DISCOUNTED FUTURE NET RETURNS, AND TREE COSTS FOR FIRST 10 YEARS FOR PERMANENT TREES.

The values of investments are influenced by two factors, one, the expected future earnings discounted to date; and two, the cost of replacement. Because it takes many years to develop an orchard to the point of large yields, at any given time cost of production of a new orchard would have little to do with the value of mature trees. Therefore, the value of a mature bearing orchard would depend largely on the expected future income. In determining the value of a very young, non-bearing orchard the cost of production would have considerable weight. In three or four years it could be duplicated. The cost of producing a tree is more an indirect influence, a threat that the price of apples in the future may change due to overplanting.

The bearing 15-year old tree cannot be immediately replaced, but trees planted now influence the future expected returns from it, and so the cost of growing trees would have some influence on value of orchards which will still be bearing 20 years hence.

Of course, waves of overplanting due to propaganda and unrelated to the item of cost may have a considerable effect on value of trees already planted.

In figure 17 curves are drawn expressing the sum of the annual net incomes discounted backward from the sixtieth year at the rate of seven per cent, to account for interest, taxes, etc. This is based on the assumption that at the end of the sixtieth year the tree is no longer commercially profitable and has no value. Another curve is drawn to represent the cost in the early period. It is thought that a freehand curve based on these two curves, the cost in the early period and the discounted net earnings in the later period, would roughly describe the relative value of trees at each age.

The future annual net incomes, many of which are some distance in the future, are dependent upon continuous skilled attention and management, a situation too elusive and insecure to warrant an individual paying for an orchard on the basis of the total future net earnings discounted. But under the assumptions made earlier this would be the ceiling of value. In the curve drawn freehand in figure 17, the peak of value is suggested at $15 in the twenty-third year. Another curve is indicated if $12 is taken as the peak value.

A peak of value at the twenty-third year is a point where current income more than balances current expenses, and the high-yielding period of the orchard's life is immediately ahead.

A number of apple men have been asked informally to designate the age at which an apple orchard would have the greatest value, and many of them have at first indicated the point of greatest yields. Yet on more deliberation they acknowledged that the age of greatest value would come before the period of largest net income. This is mentioned here to indicate that orchardists have not been discussing problems of this sort because they are not normally facing either the sale or purchase of orchards, especially orchards by age classes. The same operators will suggest unhesitatingly that a cow or a horse is of greatest value previous to its period of greatest yield.

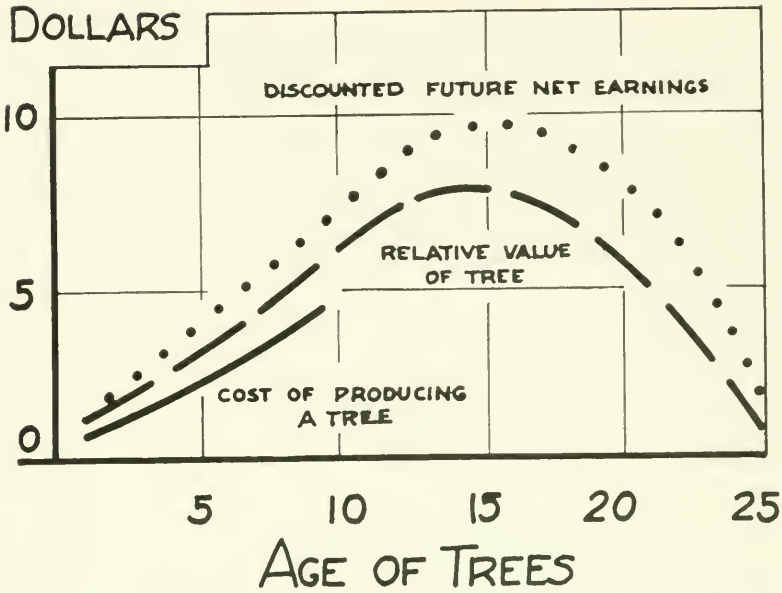

FIGURE 18.—INVENTORY VALUE PER TREE DERIVED FROM DISCOUNTED FUTURE NET RETURNS, AND TREE COSTS FOR FIRST 10 YEARS FOR SEMI-PERMANENT TREES.

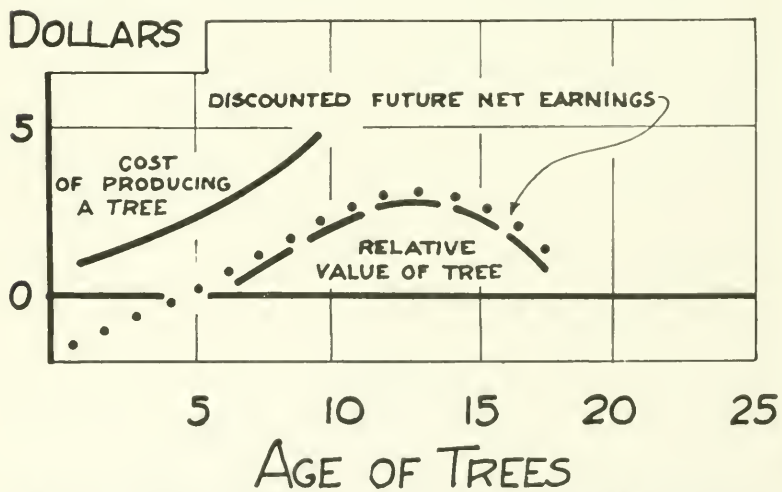

FIGURE 19.—INVENTORY VALUE PER TREE DERIVED FROM DISCOUNTED FUTURE NET RETURNS, AND TREE COSTS FOR FIRST 10 YEARS FOR FILLER TREES.

Value of semi-permanents

In figure 18 are the curves representing the sum of the future annual net incomes from semi-permanent trees discounted backward from the twenty-fifth year, also the estimated cost curve for the first 10 years.

This assumes that these trees would be cut out at the end of the twenty-fifth year and would have no value. Based on these two curves a preliminary line was drawn freehand. Since the value of the permanent trees (Fig. 17) was placed at $15 or about $10 below the discounted value of expected future income, the semi-permanent value was put at $8 at 15 years to be in line with the value of permanent trees.

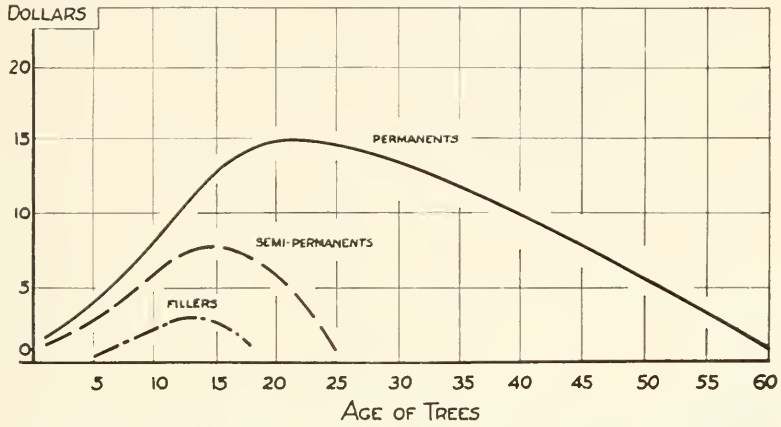

FIGURE 20.—COMPARISON OF INVENTORY VALUE PER TREE FOR THE THREE TYPES OF TREES.

Fillers

The expected net income for fillers discounted backward from the eighteenth year is much below the cost of production line, with a peak of $3.30 at the thirteenth year. The discounted value of the expected incomes would be the maximum value and since the earnings are close at hand, a curve with a peak of $3.30 at the thirteenth year was considered to be in line with the others. (Fig. 19.)

Comparison of the three methods

In figure 20 the value curves of the three types of trees are shown. The position of these curves substantiates the conclusions on page 15 on the use of semi-permanents and fillers. The filler tree in its short life of 18 years yields only 20 boxes of apples, the semi-permanent in its 25 years yields 56 boxes, as compared to a total yield of 250 boxes for the permanent tree.

The costs in the first 18 years are not significantly different. These conclusions on planting apply to New Hampshire conditions.

These budget analysis curves, of course, are based on the sod mulch system under New England conditions. Entirely different conclusions would be made under conditions existing in other sections. For instance, under the conditions of the Pacific Northwest with high costs for water rights, with heavy labor requirement, with irrigation, with high yields of apples, and with a short cycle of commercial life, the costs associated with the land area are important. Under such conditions, close plantings, with removal of part of the trees at a later period may be a sound procedure. In New Hampshire where use of land is a minor cost the reverse is true.